

wherein the at least one metal-hyperaccumulator plant is selected from the group consisting of nickel-hyperaccumulating plants that accumulate at least about 1000 mg of nickel per 1 kg dry weight of plant tissue, cobalt-hyperaccumulating plants that accumulate at least about 1000 mg of cobalt per 1 kg dry weight of plant tissue, zinc-hyperaccumulating plants that accumulate at least about 10,000 mg of zinc per 1 kg dry weight of plant tissue, manganese-hyperaccumulating plants that accumulate at least about 10,000 mg of manganese per 1 kg dry weight of plant tissue, and cadmium-hyperaccumulating plants that accumulate at least about 100 mg of cadmium per 1 kg dry weight of plant tissue.

REMARKS

Claims 1-47 are pending. Claims 5-7, 19-37, and 41-47 have been withdrawn from consideration. Claims 1-4, 8-18, 38-40 and 48 are rejected. Claims 1, 10 and 38 are amended and new claim 49 added. Support for the amendments and new claims can be found throughout the application, for instance at page 10 of the specification and in the claims as originally filed. No new matter has been added. Applicants respectfully request reconsideration and withdrawal of all rejections.

Double Patenting

Claims 1-4, 8-18 and 34-40 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-12 of U.S. Patent No. 5,944,872 (the "872 Patent"). Applicants are in the process of obtaining a Terminal Disclaimer to overcome this rejection and will submit the Disclaimer in a Supplemental Paper which will soon follow this Response and, therefore, requests that

the double patenting rejection be held in abeyance pending submission of the Terminal Disclaimer.

Claim Rejection - 35 U.S.C. 103

Claims 1-4, 8, 12, 13, 16-18, 38-40 and 40 are rejected under 35 U.S.C. 103(a) as being obvious over Raskin et al. (U.S. Patent No. 5,785,735). It is alleged that elevating the pH of a soil from an initial pH to a pH of at least 5.6 is within the range of optimum pH conditions disclosed by Raskin et al.

Applicants respectfully disagree. The present invention in a preferred embodiment is concerned with a method for selectively increasing the amount of at least one metal recovered from metal-containing soil comprising: (a) elevating the pH of the soil from an initial pH to a raised pH of 5.6 to 9.5; and (b) cultivating at least one metal-hyperaccumulator plant in the soil having the raised pH under conditions sufficient to permit said at least one plant to accumulate said at least one metal from the soil in above-ground tissue. The at least one metal-hyperaccumulator plant is selected from the group consisting of nickel-hyperaccumulator plants that accumulate at least about 1000 mg of nickel per 1 kg dry weight of plant tissue, cobalt-hyperaccumulator plants that accumulate at least about 1000 mg of cobalt per 1 kg dry weight of plant tissue, zinc-hyperaccumulator plants that accumulate at least about 10,000 mg of zinc per 1 kg dry weight of plant tissue, manganese-hyperaccumulator plants that accumulate at least about 10,000 mg of manganese per 1 kg dry weight of plant tissue, and cadmium-hyperaccumulator plants that accumulate at least about 100 mg of cadmium per 1 kg dry weight of plant tissue (See claim 1).

In another preferred embodiment, the present invention is concerned with a

method for recovering nickel from nickel-containing soil comprising: (a) elevating the pH of the soil from an initial pH to a raised pH of 5.6 to 9.5; and (b) cultivating at least one nickel-hyperaccumulator plant in the soil having the raised pH under conditions such that at least 0.1% of the above-ground tissue of said at least one plant, on a dry weight basis, is nickel; (c) harvesting said at least one plant; and (d) recovering nickel from said harvested plant (See claim 10).

Also, in another preferred embodiment, the present invention is concerned with a method for decontaminating metal-containing soil, comprising cultivating at least one hyperaccumulator plant in metal-containing soil, whereby the concentration of metal in the above-ground plant tissue of said at least one hyperaccumulator plant exceeds the concentration of metal in said soil by a factor of at least 2. The at least one metal-hyperaccumulator plant is selected from the group consisting of nickel-hyperaccumulator plants that accumulate at least about 1000 mg of nickel per 1 kg dry weight of plant tissue, cobalt-hyperaccumulator plants that accumulate at least about 1000 mg of cobalt per 1kg dry weight of plant tissue, zinc-hyperaccumulator plants that accumulate at least about 10,000 mg of zinc per 1 kg dry weight of plant tissue, manganese-hyperaccumulator plants that accumulate at least about 10,000 mg of manganese per 1 kg dry weight of plant tissue, and cadmium-hyperaccumulator plants that accumulate at least about 100 mg of cadmium per 1 kg dry weight of plant tissue (See claim 38).

Therefore, Applicants respectfully urge that no such invention as claimed is taught or suggested in the prior art including the cited reference. Applicants wish to emphasize that in claims 1 and 38, the claimed invention requires that the metal-hyperaccumulator plant is selected from the group consisting of nickel-hyperaccumulator plants that accumulate at least about 1000 mg of nickel per 1 kg dry weight of plant tissue, cobalt-hyperaccumulator plants that accumulate at least about

1000 mg of cobalt per 1kg dry weight of plant tissue, zinc-hyperaccumulator plants that accumulate at least about 10,000 mg of zinc per 1 kg dry weight of plant tissue, manganese-hyperaccumulator plants that accumulate at least about 10,000 mg of manganese per 1 kg dry weight of plant tissue, and cadmium-hyperaccumulator plants that accumulate at least about 100 mg of cadmium per 1 kg dry weight of plant tissue (See claims 1 and 38). Also, in claim 10, the claimed invention requires at least one nickel-hyperaccumulator plant in soil, so that at least 0.1% of the above-ground tissue of said at least one plant, on a dry weight basis, is nickel (See claim 10). Accordingly, Applicants respectfully point out that Raskin et al. contains no teaching or suggestion with respect to any such hyperaccumulator plants as set forth in the claimed invention. In fact, Applicants wish to emphasize that in addition to the metal-hyperaccumulator plants listed and exemplified in the specification, a variety of other non-*Alyssum* and non-*Brassica* plants including varieties of *Thlaspi* and *Berkheya* that have naturally occurring metal hyperaccumulation characteristics have been found to be suitable in the claimed invention, as explained in the Declaration. Nevertheless, Raskin et al. is unable to provide any disclosure whether teaching or suggestion of any plant capable of hyperaccumulation of metals, in accordance with the claimed invention.

Indeed, and perhaps more important, Applicants urge that the plants of Raskin et al. are not hyperaccumulator plants in accordance with the claimed invention, as can be seen from the Declaration of Yin-Ming Li (attached), one of the inventors of the claimed invention. First, Raskin et al. focuses exclusively on members of Brassicaceae and thus by definition excludes all of the non-Brassicaceae species identified in the present invention. Second, Raskin et al. specifically excludes the wild or natural hyperaccumulators of the claimed invention, which are members of Brassicaceae. Third, as stated throughout the Declaration, the plants of Raskin et al. fail to hyperaccumulate metals in accordance with the claimed invention. In fact, it is pointed

out in the Declaration that the elaborate and expensive treatments of Raskin et al. to induce metal-hyperaccumulation have been unsuccessful in that the plants of Raskin et al. are not metal-tolerant and thus the treatments often lead to plant death or at least non-viability. Again, Raskin et al. is unable to teach or suggest each and every element of the claimed invention.

Finally, Applicants wish to again point out that the claimed invention is concerned with metal-hyperaccumulation through elevating the pH of the soil from an initial pH to a raised pH of at least 5.6 (See claim 49), or elevating the pH of the soil from an initial pH to a raised pH of 5.6 to 9.5 (See claim 1). As previously argued, and as confirmed in the Declaration, Raskin et al. is concerned with the opposite of increased shoot metal by decreasing soil pH, which is the normal plant response as would be recognized by those of ordinary skill in the art. Indeed, while Raskin et al. may appear to be concerned with maintaining the production of Brassicaceae so that the removal of metals though a decrease in the pH of metal-containing soils is possible, Raskin et al. makes it clear that the balancing of plant production and metal removal is achieved by "dropping" the pH of the metal-contaminated soil to about 4.5-5.5 (See column 8, lines 1-2), even though yields of Brassicaceae are reduced at pH levels below about 5.5 (See column 8, lines 25-26). Thus, at the very least, in teaching that "decreasing", "dropping" or "lowering" the pH to 5.5 or less is necessary for metal removal, Raskin et al. clearly cannot be considered to teach or suggest an elevation of pH, in accordance with the claimed invention. Applicants therefore urge withdrawal of the rejection.

Claims 1-4, 8-18, 34-40 and 48 are also rejected under 35 U.S.C. 103(a) as being obvious over Raskin et al. in view of Brooks et al. (Vegetation 45, pp. 183-188, 1981). It is alleged that it would have been obvious to incorporate the teachings of Brooks et al. in the disclosure of Raskin et al. so as to selectively remove Ni from Ni-

contaminated soil using an Alyssum species.

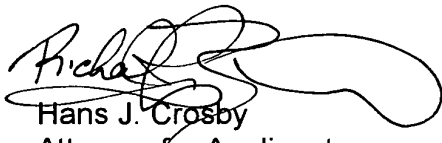
Applicants respectfully disagree. As discussed above, Raskin et al. is unable to teach or suggest each and every element of the claimed invention. Applicants therefore point out that Brooks is unable to cure the deficiencies of Raskin et al. It is to be noted that Brooks et al. has been cited merely for the disclosure of Ni accumulation in Alyssum. Brooks et al. is also unable to teach or suggest any metal-hyperaccumulator plants, metal-hyperaccumulation, or elevation in pH, as required by the claimed invention. Accordingly, no combination of the cited references can be considered to teach or suggest the claimed invention. Applicants urge withdrawal of all rejections.

In view of the amendments and above remarks, Applicants respectfully submit that this application is in condition for allowance and request favorable action thereon.

In the event this paper is not considered to be timely filed, Applicants hereby petition for an appropriate extension of time. The fee for this extension may be charged to our Deposit Account No. 01-2300. The Commissioner is hereby authorized to charge any fee deficiency or credit any overpayment associated with this communication to Deposit Account No. 01-2300, referencing Attorney Docket No. 108172-00037.

Respectfully submitted,

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Enclosures: Marked-Up Copy of the Claims
Terminal Disclaimer
Declaration of Yin-Ming Li

MARKED-UP COPY OF THE CLAIMS

1 (Amended). A method for selectively increasing the amount of at least one metal recovered from metal-containing soil comprising:

- (a) elevating the pH of the soil from an initial pH to a raised pH of [at least] 5.6 to 9.5; and
- (b) cultivating at least one metal-hyperaccumulator plant in the soil having the raised pH under conditions sufficient to permit said at least one plant to accumulate said at least one metal from the soil in above-ground tissue, wherein the at least one metal-hyperaccumulator plant is selected from the group consisting of nickel-hyperaccumulator plants that accumulate at least about 1000 mg of nickel per 1 kg dry weight of plant tissue, cobalt-hyperaccumulator plants that accumulate at least about 1000 mg of cobalt per 1kg dry weight of plant tissue, zinc-hyperaccumulator plants that accumulate at least about 10,000 mg of zinc per 1 kg dry weight of plant tissue, manganese-hyperaccumulator plants that accumulate at least about 10,000 mg of manganese per 1 kg dry weight of plant tissue, and cadmium-hyperaccumulator plants that accumulate at least about 100 mg of cadmium per 1 kg dry weight of plant tissue.

10 (Amended). A method for recovering nickel from nickel-containing soil comprising:

- (a) elevating the pH of the soil from an initial pH to a raised pH of [at least] 5.6 to 9.5; and

- (b) cultivating at least one nickel-hyperaccumulator plant in the soil having the raised pH under conditions such that at least 0.1% of the above-ground tissue of said at least one plant, on a dry weight basis, is nickel;
- (c) harvesting said at least one plant; and
- (d) recovering nickel from said harvested plant.

38 (Amended). A method for decontaminating metal-containing soil, comprising cultivating at least one hyperaccumulator plant in metal-containing soil, whereby the concentration of metal in the above-ground plant tissue of said at least one hyperaccumulator plant exceeds the concentration of metal in said soil by a factor of at least 2;

wherein the at least one metal-hyperaccumulator plant is selected from the group consisting of nickel-hyperaccumulator plants that accumulate at least about 1000 mg of nickel per 1 kg dry weight of plant tissue, cobalt-hyperaccumulator plants that accumulate at least about 1000 mg of cobalt per 1 kg dry weight of plant tissue, zinc-hyperaccumulator plants that accumulate at least about 10,000 mg of zinc per 1 kg dry weight of plant tissue, manganese-hyperaccumulator plants that accumulate at least about 10,000 mg of manganese per 1 kg dry weight of plant tissue, and cadmium-hyperaccumulator plants that accumulate at least about 100 mg of cadmium per 1 kg dry weight of plant tissue.